Adult and Juvenile Coho Salmon Enumeration and Coded-wire Tag Recovery Analysis for Zolzap Creek, BC, 1998

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Fisheries and Oceans Canada
Room 202, 417-2nd Ave.
Prince Rupert, BC
V8J 1G8

2001

Canadian Manuscript Report of Fisheries and Aquatic Sciences No. 2566

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Canadian Manuscript Report of
Fisheries and Aquatic Sciences 2566

2001

ADULT AND JUVENILE COHO SALMON ENUMERATION AND CODED-WIRE TAG RECOVERY ANALYSIS FOR ZOLZAP CREEK, BC, 1998

by

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Cat. No. Fs 99-4/2566E ISSN 0706-6473

Correct citation for this publication:

Baxter, B.E., C.Y. Stephens and B.L. Nass. 2001. Adult and juvenile coho salmon enumeration and coded-wire tag recovery analysis for Zolzap Creek, BC, 1998. Can. Manuscr. Rep. Fish. Aquat. Sci. 2566: viii + 44 p.

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ABSTRACT

Baxter, B.E., C.Y. Stephens and B.L. Nass. 2001. Adult and juvenile coho salmon enumeration and coded-wire tag recovery analysis for Zolzap Creek, BC, 1998. Can. Manuscr. Rep. Fish. Aquat. Sci. 2566: viii + 44 p.

Adult and juvenile coho migrations were monitored at Zolzap Creek, British Columbia, as part of the 1998-1999 Nisga'a Aboriginal Fisheries Strategy. The 1998 season is the seventh year of continuous operation of the Zolzap Creek. This report includes seven year summaries of the most pertinent data. Smolt trapping was conducted from 28 April to 23 June 1998 using an instream wire-mesh fence. A total of 15,937 coho smolts were captured during the trapping period, and an unknown number migrated out during periods when the fence was not operational. Of those captured, 13,950 were released with coded-wire tags. Migration timing, mean length and weight at age, and age composition are presented.

Adult coho escapement was monitored using an instream fence and carcass surveys. The counting fence was operational between 31 August and 19 November. A total of 967 adult coho were counted at the fence. Adipose-clip rate was 22.0% for adult coho. Age and length characteristics of adult males and females are presented.

Canadian and US commercial harvests were examined using coded-wire tag recovery data obtained from the Mark-Recovery Program and the Alaskan Department of Fish and Game (ADF&G) mark tag and age lab online database. Total commercial exploitation rate on Zolzap Creek coho in 1998 was 46.0% (0.0% Canadian, 46.0% US). Of the total commercial catch of Zolzap Creek coho, Canadian catch accounted for 0.0% and the US catch accounted for an estimated 100%. Harvests occurred over a wide area ranging from S.E. Alaska to the US Northern Outside Statistical Area in Alaska (northwest of Juneau, AK). Due to concerns over declining coho stocks, the Canadian fishery was shut down for coho harvests this year. No CWT returns were received from the Canadian fisheries for Zolzap Creek in 1998. US harvests of Zolzap coho in Alaska were largest in the Southern Inside Statistical Area for the net fishery and the Central Outside Statistical Area for the troll fishery. Total survival was 2.9% and smolt-to-spawner survival was 1.6%.

RÉSUMÉ

Baxter, B.E., C.Y. Stephens and B.L. Nass. 2001. Adult and juvenile coho salmon enumeration and coded-wire tag recovery analysis for Zolzap Creek, BC, 1998. Can. Manuscr. Rep. Fish. Aquat. Sci. 2566: viii + 44 p.

Les migrations de saumons coho, adultes et jeunes, ont été mesurées au ruisseau Zolzap en Colombie-Britannique, dans le cadre de la Stratégie des pêcheries autochtones des Nisga'a en 1998-1999. L'année 1998 marque la 7ième saison d'opération continue des barrières en fil métallique du ruisseau Zolzap. Ce rapport contient 7 ans de sommaires des données les plus intéressantes. Le piégeage des saumoneaux prit place entre le 28 avril et le 23 juin 1998 à l'aide d'une barrière en fil métallique installée dans le ruisseau. En tout, 15,937 saumoneaux coho ont été capturés pendant la période de piégeage tandis qu'un nombre inconnu a migré quand la barrière n'était pas opérationelle. Sur l'ensemble des saumoneaux capturés, 13,950 ont été remis à l'eau avec une marque magnétique codée. La période de migration, la longueur moyenne, le poids et la composition selon l'âge sont présentées.

La remonte de saumons coho adultes a été surveillée grâce à une barrière installée dans le ruisseau et à l'observation des carcasses. La barrière de comptage fut opérationelle entre le 31 août et le 19 novembre. Un total de 967 saumons coho adultes ont été dénombrés à la barrière. Le taux d'ablation de la nageoire adipeuse était de 22.0% pour les saumons coho adultes. Nous présentons les caractéristiques d'âge et de longueur pour les mâles et les femelles adultes.

Les récoltes commerciales canadiennes et américaines ont été examinées grâce aux données de récupération des marques magnétiques codées provenant du Programme de marquage-récupération et en direct de la base de données du Département de Pêche et Chasse de l'Alaska. En 1998 le taux total d'exploitation commerciale de saumon coho au ruisseau Zolzap fut évalué à 46.0% (0.0% pour le Canada, 46.0% pour les États-Unis). Sur le total de prises commerciales de saumon coho au ruisseau Zolzap, le Canada en comptait 0.0% et les États-Unis, une estimation de 100%. Les récoltes couvraient un vaste secteur, s'étendant à partir du sud-est de l'Alaska jusqu'à la zone statistique nord extérieure de l'Alaska aux États-Unis (au nord-ouest de Juneau, AK). Étant donné les souçis concernant le déclin des stock de coho la pêche canadienne pour récoltes de coho fut cancellée cette année. Nous n'avons reçu aucune donnée de récupération des marques magnétiques codées des pêches canadiennes au ruisseau Zolzap pour l'année 1998. Les saumons coho du Zolzap récoltés par les États-Unis en Alaska furent plus nombreux dans la zone statistique sud intérieure pour la pêche au filet, et, dans la zone statistique centrale extérieure pour la pêche à la traîne. Le taux total de survie fut 2.9% tandis que pour les saumoneaux/géniteurs le taux de survie fut 1.6%.

INTRODUCTION

As part of an agreement between the Nisga'a Tribal Council and the Canadian Government, an Interim Measures Program (IMP) was established for fisheries research in the Nisga'a Traditional Territory, British Columbia. One component of this large research initiative focused on the assessment of juvenile and adult coho populations in tributaries to the Nass River. Juvenile and adult coho enumeration studies have been conducted on Zolzap Creek since 1992 (Nass 1996a; Nass 1996b; Nass and English 1994; Nass 1996c; Nass 1997a; Nass 1997b; Nass 1999; Nass and Frith 1999). This report presents results for studies conducted at Zolzap Creek in 1998.

The objectives of the research were to:

1. Enumerate migrating juvenile coho and estimate escapement;
2. Document the timing, size, and age distribution of migrating coho;
3. Mark coho smolts with coded-wire tags (CWT) to enable the determination of oceanic harvest rates;
4. Monitor the escapement for marked (CWT) adult coho, and determine oceanic exploitation and survival rates; and
5. Collect water temperature and level data for future examination of the relationships between physical environmental factors and coho smolt migration timing, and between adult escapement and smolt production.

Achievement of these objectives involved the construction and operation of instream, semi-permanent, panel fences located approximately 0.5 km upstream of the mouth of Zolzap Creek.

STUDY STREAM

Zolzap Creek is a tributary to the Nass River, located in northwestern British Columbia (Fig. 1 and 2). Zolzap Creek flows for 6 km in a northwesterly direction between Nisga'a Lava Bed Memorial Park and the Kitimat Mountain Range to its confluence with the Nass River, 5 km downstream of Gitwinksihlkw. The main channel of the creek is regularly interrupted by beaver dams and log jams. The substrate is highly variable and ranges between silty particulate to granite cobble, and coarse pumice. Major flow contributions come from Lava Creek (3 km in length) which flows from the lava beds and numerous small creeks that flow from the steep alpine. Intermittent flows of water from the Nass River and Vedder Creek are possible during flooding periods. The mouth of Zolzap Creek enters a side channel to the Nass River known as Zolzap Slough. The lower 0.5 km of Zolzap Creek regularly becomes inundated when water levels on the Nass River are high. Zolzap Creek supports many species of salmonids including

coho (*Oncorhynchus kisutch*), pink (*O. gorbuscha*), chum (*O. keta*), sockeye (*O. nerka*), rainbow (*O. mykiss*), cutthroat (*O. clarki*), and Dolly Varden (*Salvelinus malma*). Non-coho species include lampreys (family Petromyzontidae), sticklebacks (family Gasterosteidae), and sculpins (family Cottidae). Coho escapement was estimated to be 1,561 in 1992 (Nass 1996b); 1,048 in 1993 (Nass 1996c); 2,536 in 1994 (Nass 1997a); 908 in 1995 (Nass 1997b); 1,039 in 1996 (Nass 1998) and 470 in 1997 (Nass and Frith 1999).

JUVENILE COHO STUDIES

METHODS

Trapping Operations

An instream, semi-permanent enumeration fence was located 0.5 km upstream of the creek mouth for the capture of downstream migrating coho smolts. Fence design was based on Conlin and Tutty (1979) and minor modifications were required due to site characteristics and available materials. The fence was built in a W-pattern and spanned the entire creek bed. Three by eight foot panels constructed of 2"x 4"s and covered with 1/4" wire-mesh were laid on their long side in the creek bed to form the fence. Rebar of 3/8" and ½" diameter were used to anchor the panels to the stream bed. A second layer of panels was installed on top of the first row of panels to create a fence with a total height of six feet. Burlap sandbags and heavy duty plastic garden sheeting were used to seal the base of the panels. Two hinged panels were installed in each of the fence wings for release of excess water in the event of flooding. Plywood trap boxes with Vexar-screened windows (to allow water exchange) were anchored at each downstream apex and were connected to the fence with 8" Big-O tubing. Additional boxes were made for holding fish after processing and were designed with a small door for releasing fish. Provisions for upstream migrating adults were made by constructing a simple trap consisting of a wire-mesh panel extending out from the stream bank to one wing of the fence. Plywood was used to cover the adult trap area.

Juveniles were captured using roe-baited gee traps when the fence was inoperable due to flood conditions. During periods of low water, seining was used to supplement fence catches.

Physical Observations

Crews monitored water temperatures, water levels, and weather daily. Crews recorded temperature to the nearest degree (1° C) using a maximum-minimum thermometer and water level using staff gauges calibrated to the nearest centimeter (0.01 m). A total of three staff gauges were used; two were located within 50 m of the trapping site (one upstream, one downstream of the fence) and one approximately 1 km upstream of the fence. Precipitation was recorded on a scale of zero to five with zero representing no precipitation and five being heavy precipitation.

Fish Enumerations

Daily numbers of coho smolts captured at the fence were obtained from automatic counters on coded-wire tagging machines or by manual counts. The number of fence mortalities was added to the total count. Coho juveniles with standard lengths greater than or equal to 70 mm were identified as smolts. Coho smaller than 70 mm tended to be dark with distinct parr marks and lacked the silver colouration typical of smolts; therefore, this group consisted of pre-smolts and fry. All coho pre-smolts and fry, and non-coho species were counted and released downstream of the fence during sorting. Upstream migrating juveniles caught in the adult traps were counted and released upstream.

Biosampling

A random sample of up to 25 smolts (i.e., coho greater than or equal to 70 mm) were obtained from each day's catch. These smolts were anaesthetized and measured for fork length and weighed using an electronic scale (0.1 g). Scale sampling followed the stratified method of Ketchen, described by Ricker (1975); age sample data (column X on Table 1) included non-random samples, and length sample data (column Y on Table 1) and the calculated age representation was based on random sampling. Crews attempted to collect at least 10 scale samples from each 5 mm size class of coho for the study period. Smolts from under-represented size classes were selected to supplement random samples. Mean length and weight data were determined by multiplying the mean length and weight data for each 5 mm bin class by the total number of length and weight samples in that bin class (factor) to come up with an average weighted length and weight for that bin class. The average length and weight for all sampled fish was determined by summing all the weighted length and weight measurements and dividing by the overall sum of the factors. Scale samples were interpreted by Birkenhead Scale Analyses, Lone Butte, BC. Secondary quality control checks were performed to ensure a reliable age designation. Scale ages are reported in Gilbert-Rich notation where freshwater age 2 coho (i.e., having survived two winters from egg deposition) have a single freshwater annulus.

Biosampling was also conducted on a sub-sample of cutthroat and steelhead trout and sockeye. Length, weight, scales and DNA tissue samples were obtained from adults and juveniles. No data or analysis is presented here, but the data can be obtained from the principal author.

Coded-wire Tagging

Coded-wire tagging at Zolzap Creek was performed using a Mark IV tagging machine (Northwest Marine Technology Ltd., Shaw Island, WA). Smolts were anaesthetized in a MS-222 bath prior to tagging. All tagged fish were adipose-fin clipped (AFC). The numbers of coho smolts tagged with each tag code and the number of smolts untagged were recorded. All tagged smolts were placed in a holding box in the stream and allowed to recover from the tagging operation before release.

Tag retention tests were conducted for each tag code. A sample of tagged coho smolts (minimum of 200 smolts) were retained in a holding box from 24 h to 96 h. Following the holding period, smolts were lightly anaesthetized and checked for the presence of a coded-wire tag using the quality control device (QCD) from the coded-wire tagging machine. Coho smolts not possessing a tag were checked a second time. The total number of tags detected for each tag group and the total number of fish tested were recorded.

RESULTS

Physical Observations

Water temperatures during the smolt migration period at Zolzap Creek ranged from a minimum of 6° C in late April to a maximum of 13° C in mid-June (Fig. 3A). Water level at gauge 2 (50 m upstream of the fence) remained steady at a gauge height of 0.3 m from the beginning of monitoring on 29 April until 23 May. Water level rose sharply to 2.1 m within 5 days following 23 May and flooded the fence during the period 28 May to 1 June. Water levels continued to fluctuate between 0.3 m and 1.4 m until the end of the spring monitoring period on 23 June. High water levels in Zolzap Creek occur when the Nass mainstem flow rises causing water to back-up into the creek. Water flow in Zolzap Creek declines to very low velocities during these flooding events.

Fish Enumerations

The Zolzap Creek juvenile counting fence was operated from 29 April to 23 June 1998. Seining was used to supplement catches at the fence during periods of low water. In addition, approximately 25 to 30 baited gee traps were used during the flooding of the fence and for a short period after.

Coho Smolts: A total of 15,937 coho smolts were counted at the fence (Table 2). This total includes catches from seining and gee trapping. The maximum daily number of smolts captured at the fence was 1,593 and occurred on 19 May (Table A-1; Fig. 4). An unknown number of smolts moved past the trapping location during fence flooding. An additional 3,000 smolts were estimated to have left the system based on the pattern of migration. There were a total of 1,528 fry and pre-smolt coho counted and released during trapping operations and 14 mortalities (Table A-1).

Non-coho Species: Lampreys (larvae and young adults) were caught in the largest numbers followed by juvenile sockeye, Dolly Varden and chum (Table 3; Table B-1).

Biosampling-Length, Weight, and Age

The mean fork length of age 2 smolts was 99.0 mm and the mean weight was 9.8 g (Table 1). Age 3 smolts averaged 110.7 mm and 13.8 g and age 4 smolts averaged 129.5 mm and 21.5 g. The length-frequency distribution showed substantial overlap between age 2 and age 3 coho

(Fig. 5). Age 2 smolts and age 3 smolts were most numerous in the 100-105 mm length class. Age 3 coho smolts were significantly larger than age 2 smolts (t-test, $p < 0.05$). Overall, coho smolts averaged 104.1 mm in length. The calculated freshwater age structure of coho smolts was 58.3% age 2, 40.5% age 3 and 1.2% age 4 (Table 1).

Coded-wire Tagging

Mean tag retention was 99.6% (Table 4). Crews conducted ten tests for tag code 28-16-21 for a total of 1,965 samples with a total of 7 tag losses.

Releases of adipose-clipped coho totalled 13,950 (Table 5; Table C-1). Crews recorded 108 mortalities associated with the tagging process. The total number of coho smolts released with coded-wire tags was 13,900. Approximately 11% (1,771) of the captured coho smolts were released untagged during the study period and thus the mark rate of coho smolts released was 1.13 (Table 5). The total number of smolts released was 15,721.

ADULT COHO STUDIES

METHODS

Population Estimates

An aluminum conduit fence anchored to a crib-type sill was constructed at Zolzap Creek. All salmonids caught at the fence were counted and classified by sex. Sex was distinguished on the basis of length and body morphology. Previous studies at Zolzap Creek (Nass 1996b; 1996c; 1997a; 1997b; Nass and Frith 1999) have shown an absence of jacks in the escapement and, therefore, all males were classified as adults. "Jack panels" consisting of 1" wire mesh were used to prevent the passage of small coho through the fence and were used whenever water levels and debris permitted. Each coho was tagged on the operculum with a uniquely numbered Ketchum kurl-lock tag and measured for length. During handling, fish were examined for fin clips or tags that would be associated with coded-wire tagging or mark-recapture studies taking place on the Nass River. All captured fish were released upstream of the fence.

Adult coho abundance downstream of the fence was assessed later in the migration period due to the lack of fish movement past the fence. Delayed migration was the result of persistent low water conditions in Zolzap Creek in the later fall period. During these periods of delayed fish movement, angling was conducted approximately 1 km downstream of the fence in Zolzap Slough to determine relative coho abundance. Coho were examined for sex and AFC's, and a uniquely numbered opercular tag was applied. All fish captured were released back into Zolzap Slough. Live coho were recaptured in upstream surveys and checked for operculum tags. Carcasses were recovered on the fence and during upstream surveys. In 1998, carcasses were recovered primarily in the lower 2 km of the creek.

Biosampling

All live coho captured at the fence were measured for postorbital-hypural length and examined for fin clips and sex. Data recorded from coho captured at the fence were used to calculate sex ratios and mean length by sex. Crews attempted to sample at least 25 coho a day for scales (10 scales per fish). Scale samples were sent to the Fisheries and Oceans Canada scale lab, Nanaimo, BC, for age determination. Secondary quality control checks were performed at the scale lab to ensure reliability of the age designations. Scale ages are reported in Gilbert-Rich notation where freshwater age 2 coho (i.e., having survived two winters from egg deposition) have a single freshwater annulus.

Adult returns (calculated by escapement method) and smolt production, by CWT and total populations, were calculated for each brood year where data were available. Smolt output and adult escapement was apportioned between brood years (back-calculated) using the age structure observed in the respective yearly migrations. The sum of freshwater age 2, age 3, and age 4 individuals equals total production for a given brood year. Age composition for smolts and adults by brood year were calculated based on the estimated production. Total survival by brood year was calculated as the age specific adult return divided by the respective smolt production. The smolt-to-spawner ratio for each brood year was calculated as the number of smolts produced divided by the number of adults in the escapement, by brood year. Similarly, the recruit-to-spawner ratio for each brood year was calculated as the number of adults produced divided by the number of adults in the escapement, by brood year.

Coded-wire Tag Recoveries

Coded-wire tagged smolts were AFC prior to release. Coho smolts at Zolzap Creek were coded-wire tagged (CWT) in the spring of 1997 (Nass and Frith 2001) during out-migration.

Escapement: Crews examined all coho captured at the fence for the presence or absence of the adipose fin. The contribution and survival of AFC coho to the escapement was determined using methods presented in Bocking et al. (1992) and modified in Nass (1997a). CWT heads were collected from fish sacrificed at the fence, fish captured at the Nass River fishwheels and Meziadin fishway, and from carcass recoveries.

Commercial and Sport Harvests: Commercial and sport catches of CWT fish are monitored by the Fisheries and Oceans Canada and various US agencies and compiled in the Mark Recovery Program (MRP). Data on CWT releases and recaptures are used to estimate the number of fish from a particular stock that have been harvested in the commercial and sport fishery, as well as determining the spatial and temporal distribution of harvests (Kuhn et al. 1988; Nass 1997a). The estimates include catch (observed catch corrected for sampling effort), expanded catch (estimated catch corrected for unmarked fish), exploitation rate (proportion of CWT coho caught in the fishery), and total return (expanded catch plus escapement).

Geographic Distribution of Harvest: Coded-wire tagged fish in the commercial catch are recorded by Canadian and US fishery Statistical Areas. To estimate number of recoveries for each Canadian area, the observed CWT catch was expanded by the mean catch sampling ratio observed in the catch region (e.g., Northern Troll = Statistical Areas 1, 3, 4, and 6). Similarly, US troll catch was expanded using the catch sampling ratio by quadrant (e.g., northwest) and the net catch sampling ratios, by district.

RESULTS

Physical Observations

During the period that the adult fence was operational, water temperatures ranged from a maximum of 12° C in early September to a minimum of 3° C in mid November (Fig. 3B). Water level ranged from 0.2 m during base flows to 0.5 m during freshets (Fig. 3B).

Adult Enumerations

The fence was operated continuously from 31 August to 19 November. A total of 967 adult coho salmon were counted at the fence (Table 6). Of these, 947 adults were operculum tagged and released upstream. Maximum daily migration past the fence was 290 adults on 6 October (Table D-1; Fig. 6).

Coho population assessments below the fence were conducted on 10, 11, 17, 21 October and 11, 12 November. A total of 54 coho were captured using angling. All coho were sexed, opercular tagged and checked for AFC's. Of the 54 tagged coho released, none were recaptured below the fence during the surveys, and 41 (76%) were observed at the fence. Therefore, at least 13 coho remained below the fence.

Eleven surveys were conducted upstream of the fence from 17 October to 30 November at four access locations along the creek. Upstream surveys were conducted on 17 October in areas within 1 km above the fence; 19, 21, 29 October and 3, 6, 30 November at Goat Creek (a tributary); 30 October and 2, 6, 10, 23, 30 November at upper Zolzap Creek. A total of 166 adult coho (114 live, 52 dead) were examined during upstream surveys (fence to 2 km) and on the fence (Table 6). All but one coho had been tagged at the fence; therefore, no mark-recapture estimate was calculated.

For non-coho species captured at the fence, Dolly Varden had the greatest abundance (30), followed by chum (24), and pink (23). Cutthroat (14), sockeye (10), steelhead (4) and lamprey (1) were also captured at the fence (Table 3). Chum and pink were caught in their greatest numbers in early September and sockeye were caught mainly in early October. Cutthroat and Dolly Varden were caught mainly in mid-October. The number of chum and sockeye caught in 1998 were less than in 1997. The number of cutthroat and Dolly Varden were more than in 1997. No population estimates were derived for non-coho species.

Biosampling-Age and Length

A total of 324 coho were sampled for scales, of which 243 were successfully aged (Table 7). Unaged samples included marine regenerates. Adult males and females had different age compositions which averaged 35.1% and 28.4% freshwater age 2, and 64.9% and 71.6% freshwater age 3, respectively. The total age composition was 32.1% age 2 and 67.9% age 3. All aged scales were recorded as marine age 1 (i.e., having 1 marine annulus).

Mean lengths of adult males and females were 51.5 cm (n=469, SD=9.05) and 56.7 cm (n=405, SD=3.88), respectively. Adult male coho were widely distributed over the range of 29 to 77 cm with a mode of 57 cm (Fig. 7). Female coho had a mode of 57 cm with a range of 43 to 68 cm. For coho sexed during processing, adult males captured at the fence (n=517) were more abundant than females (n=437).

Coded-wire Tag Recoveries

Escapement: Crews examined 963 adult coho at the fence for fin clips of which 212 were AFC (22%; Table 8). An estimated 213 adipose-clipped adult coho returned to Zolzap Creek in 1998. In addition, of the 54 coho examined below the fence, 2 (0.04%) were AFC. Of the 2 AFC coho tagged below the fence, both were observed at the fence. Smolt to spawner survival (i.e., includes natural and harvest mortality) for adult coho was estimated at 1.6%.

Thirty-five (35) CWT heads were collected at Zolzap Creek. Of these recoveries, 17 were from sacrifices at the fence and 18 were from carcass recoveries. In addition, 6 coho with adipose clips were recovered at the Nass River fishwheels and 1 coho was recovered with an adipose clip at the Meziadin fishway. All the CWT recoveries from Zolzap Creek were from the 1997 release at Zolzap Creek (code 28-16-20). Of the 6 fishwheel CWT recoveries, 3 were from the 1997 release at Zolzap Creek (code 28-16-20), 1 was from the 1997 release at Ft. Babine (code 18-17-6), 1 was from the 1997 release at Toboggan Creek (code 18-11-43), and 1 was a No-Pin. The 1 CWT recovery at the Meziadin Fishway was from the 1997 release at Ft. Babine (code 18-23-8).

Commercial and Sport Harvests: Total observed Zolzap Creek coho CWT recoveries were 0 and 60 for Canadian and US (Alaska) fisheries, respectively (Table 9). Observed sport recoveries totalled zero for the Canadian fisheries and one for the Alaskan fishery. All CWT recoveries were from the 1997 release year. Northern Canadian troll catch-to-sample ratio was 0.0, while US troll and net ratios were 2.6 and 5.4, respectively (Table 9). Estimated Zolzap Creek CWT coho catches were 0 (0%) and 184 (100%) for Canadian and US fisheries, respectively (Table 9).

Expanded Canadian and US catches were 0 and 198, respectively, for a total of 198 using the CWT mark ratio at release (i.e., MRP method) (Table 10). Expanded Canadian and US catches were zero and 899, respectively, for a total of 899 using the adipose-clip ratio at recovery

(i.e., escapement method). Estimated total adult return for Zolzap Creek coho was 426 and 1,866 using the MRP and escapement methods, respectively (Table 10).

Of the total commercial catch of Zolzap Creek coho, Canadian fisheries accounted for 0% and the US accounted for 100% of the total commercial catch of Zolzap Creek coho (Table 11). US troll and net fisheries accounted for 70.6% and 29.4% of the total US catch, respectively. Commercial harvest of Zolzap Creek coho occurred over a wide area ranging from S.E. Alaska to the US Northern Outside Statistical Area in Alaska (Fig. 8). Due to restricted fisheries, no Canadian harvests were reported and no CWT returns were received from the Canadian fishery. US harvests were largest in the Southern Inside Statistical Area for the net fishery (13.3%) and the Central Outside Statistical Area for the troll fishery (27.6%; Table 11).

Total exploitation rate (Canadian and US combined) on Zolzap Creek coho in 1998 was 46.0% (Table 12). Total Canadian exploitation rate was 0% and total US exploitation rate was 46.0% (34.6% troll, 11.4% net). Total survival based on CWT returns was 2.9% (Table 12).

DISCUSSION

Over the past seven years of monitoring, the average number of smolts estimated leaving Zolzap Creek was 31,143 (Table 12). For the same time period, the average age composition of the smolt population was 57.5% age 2, 41.1% age 3, and 1.4% age 4.

Adult coho counted at the fence in 1998 totalled 967. After CWT sacrifices (n=17), escapement was 950 plus an undetermined number of coho that spawned below the fence. The native and sport fisheries harvested an unknown number of coho below the fence. Average escapement estimates for 1992-1998 were 1,218 (Table 12) which may result in survival rates being underestimated and the exploitation rates overestimated.

Data from 1992-1997 have indicated that there are no jacks in the Zolzap Creek escapement (Nass 1996b; 1996c; 1997a; 1997b; 1999; Nass and Frith 1999). In 1998, CWT and scale ageing data have confirmed again the absence of jacks in the population. There were 35 heads taken for CWT sampling from coho measured between 28 and 63 cm (post-orbital-hypural) and all were found to be from 1997 releases. Twelve of the samples were from coho measuring less than 35 cm. This length has been used in previous studies at other BC streams to designate jacks in the escapement and is based on CWT analysis. Both the CWT analysis and scale ageing show that coho less than 35 cm from Zolzap Creek in 1998 were marine age 1.

In Alaska, comprehensive information exists for several southeast stocks, including Hugh Smith Lake (Southern Inside Statistical Area, see Fig. 8), which has been monitored since 1982. Preliminary data for the 1998 return suggests exploitation rates of 0% Canadian and 77.3% US (77.3% total; Leon Shaul, Alaska Dept. of Fish and Game, Douglas, AK, pers. comm.). Southeast Alaska and Canadian fisheries accounted for approximately 100% and 0% of the commercial catch of Hugh Smith coho, respectively. The total exploitation rate on Hugh Smith coho was substantially higher than exploitation rates of 0% Canadian and 46.0% US (46.0%

total) on Zolzap Creek coho in 1998. Preliminary CWT data for the 1998 return of Hugh Smith coho suggest a survival rate of 11.4% which is substantially higher than for Zolzap Creek coho at 2.9%. Hugh Smith coho have had substantially higher survivals (1997: 8.2%; 1996: 17.9%; 1995: 13.7%; 1994: 19.4%; 1993: 13.0%) compared to Zolzap coho (1997: 2.4%; 1996: 6.6%; 1995: 3.6%; 1994: 8.9%; 1993: 2.1%) in the past five years.

Zolzap Creek CWT coho have been subjected to total exploitation rates between 46.0% and 72.3% and have had total survival rates between 2.1% and 8.9% over the period 1993 to 1998 (Table 12). Canadian fisheries have had exploitation rates between 0% and 21.4% on Zolzap CWT coho, while US fisheries ranged between 39.2% and 54.8%. Of the total commercial catch of Zolzap Creek coho, Canadian fisheries have averaged 20.1% and the US has averaged 79.9%, over six years (Table 12).

Total smolt production by brood year averaged 32,658 (1990-1994) and was composed primarily of freshwater age 2 fish (62.7%; Table 13). Adult production by brood year averaged 3,987 (1990-1994) and was 54.6% age 2 fish. Age composition at return was substantially different from that observed in the respective smolt populations and varied widely. Freshwater age 4 fish were absent from all adult escapements. Total survival by brood year of all Zolzap coho (unmarked + CWT) averaged 12.8% (1990-1994; Table 13). Total survival of Zolzap CWT coho was substantially lower at 4.7%.

The number of smolts per spawner was 9.1 for the 1994 brood year. This value is conservative as the number of smolts released was likely underestimated. The number of recruits per spawner was 0.8 for the 1994 brood year.

ACKNOWLEDGMENTS

The cooperation of many people was essential in meeting the objectives of this study. Special thanks go to Leonard Squires for monitoring all aspects of operations as crew supervisor. Peter "Normy" Squires, Tim Angus, Carol Benson, Craig McKay, Craig Haizimsque, Kevin Small, Stuart Stephens, and Lawrence Stephens assisted in constructing and operating the fence. Karl English provided technical support. Doug Herriot of the Department of Fisheries and Oceans provided the CWT catch data from the Mark Recovery Program. Robin Tamasi provided mapping support. Funding for this project was provided by the Canadian Government as part of the Nisga'a-Canada (Aboriginal Fisheries Strategy) Contribution Agreement (CA98-139).

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TABLES

Table 1. Age-length distribution of Zolzap Creek coho smolts, 1998.

Size-Class (mm)	Age Sample (X)	Age-groups in X 2	3	4	Length Sample (Y)	Calculated Age Representation in Y 2	3	4
70	3	3	0	0	4	4.0	0.0	0.0
75	10	10	0	0	10	10.0	0.0	0.0
80	14	14	0	0	15	15.0	0.0	0.0
85	32	28	4	0	33	28.9	4.1	0.0
90	112	91	21	0	121	98.3	22.7	0.0
95	149	112	37	0	158	118.8	39.2	0.0
100	189	118	70	1	198	123.6	73.3	1.0
105	126	64	62	0	132	67.0	65.0	0.0
110	78	30	48	0	84	32.3	51.7	0.0
115	49	14	33	2	51	14.6	34.3	2.1
120	24	8	16	0	25	8.3	16.7	0.0
125	9	0	8	1	9	0.0	8.0	1.0
130	16	0	14	2	18	0.0	15.8	2.3
135	9	0	8	1	11	0.0	9.8	1.2
140	11	0	9	2	12	0.0	9.8	2.2
145	7	0	6	1	7	0.0	6.0	1.0
150	2	0	2	0	3	0.0	3.0	0.0
155	2	0	2	0	3	0.0	3.0	0.0
Mean length						99.0	110.7	129.5
SD						8.8	14.1	13.7
Mean weight (g)						9.8	13.8	21.5
SD						2.5	5.8	6.3
Total samples	842	492	340	10	894	520.8	362.4	10.8
% contribution		58.4	40.4	1.2		58.3	40.5	1.2

Table 2. Coho smolt catch at Zolzap Creek enumeration fence, by week, in 1998.

Week ending	Catch
02-May	798
09-May	2,078
16-May	3,903
23-May	4,612
30-May	1,884
06-Jun	1,023
13-Jun	877
20-Jun	627
27-Jun	135
Total	15,937

Table 3. Non-coho catch at the spring juvenile and fall adult fences at Zolzap Creek, 1992-1998[a].

Species	Time/lifestage	1992	1993	1994	1995	1996	1997	1998	Avg.
Pink	Fall Adult	115	149	251	52	72	44	23	101
Chum	Spring Juvenile						344	549	447
	Fall Adult	30	111	68	8	19	42	24	43
Sockeye	Spring Juvenile	4	244	328	189	119	0	798	240
	Fall Adult	4	11	28	7	0	39	10	14
Cutthroat	Spring Juvenile	12	69	36	67	121	42	268	88
	Spring Adult	308	278	224	43	55	2	117	147
	Fall Adult	17	27	14	28	18	12	14	19
Dolly Varden	Spring Juvenile	682	309	339	518	711	337	732	518
	Spring Adult	644	728	1529	28	44	7	25	429
	Fall Adult	9	21	10	81	39	21	30	30
Steelhead	Spring Juvenile	11	15	36	12	30	4	82	27
	Spring Adult	33	0	5	0	0	0	0	5
	Fall Adult	5	0	2	0	0	0	4	2
Lamprey[b]	Spring Juvenile	749	906	1277	2314	1333	1794	2264	1520
	Spring Adult	-	-	-	-	28	97	144	90
	Fall Adult	-	-	-	2	16	4	1	6

[a] Trapping effort not equal between years.

[b] Adults and juveniles not distingushed for period 1992 - 1995.

Table 4. Coded-wire tag retention rates for Zolzap Creek coho smolts, 1998.

Sampling Date	Tagging Date	Tag code	Hours held	Sample size	No. fish no tag	Percent retention
07-May	06-May	28-16-21	24	200	1	99.5
10-May	07-May	28-16-21	72	165	0	100
12-May	11-May	28-16-21	24	200	5	97.5
14-May	12-May	28-16-21	48	200	0	100
16-May	14-May	28-16-21	48	200	0	100
17-May	16-May	28-16-21	24	200	0	100
18-May	17-May	28-16-21	24	200	0	100
19-May	18-May	28-16-21	24	200	1	99.5
21-May	19-May	28-16-21	48	200	0	100
19-Jun	15-Jun	28-16-21	96	200	0	100
Total				1,965	7	99.6

Table 5. Coded-wire tagged coho smolt releases from Zolzap Creek, 1998.

Tag code	Tagging dates	No. AFC	Tag morts	No. released AFC	No. tagged [a]	No. AFC only [b]	No. released untagged [c]	Total release [d]	CWT mark rate [e]
28-16-21	6 May - 19 June	14,058	108	13,950	13,900	50	1,771	15,721	1.13

[a] No. tagged (corrected for tag loss) = No. released AFC - (No. released AFC * No. lost tags / No. sampled); see Table 4.

[b] No. AFC only = No. released AFC - No. tagged

[c] No. released untagged = the number of unmarked fish released which belong to the same group as the tagged and AFC only fish.

[d] Total release = No. tagged + AFC only + untagged

[e] CWT mark rate = Total release / No. tagged

Table 6. Adult coho enumerations and recoveries at Zolzap Creek fence, 1998.

Item	No. of adults
Number live coho captured at fence	967
Number of live coho released untagged	3
Number of coho sacrificed at the fence	17
Number live coho operculum tagged	947
Number coho recovered (live + dead)	166
Number of coho recovered untagged (live + dead)	1
Number of coho recovered with lost tags (live + dead)	31

Table 7. Freshwater age distribution of adult coho at Zolzap Creek, 1998.

Sex	Age 2		Age 3		Total aged	Total unaged	Total sampled
	No.	%	No.	%			
Adult males	47	35.1	87	64.9	134	49	183
Adult females	31	28.4	78	71.6	109	32	141
Total adults	78	32.1	165	67.9	243	81	324

Table 8. Estimates of total escapement of adipose clipped coho and contribution to escapement at Zolzap Creek, 1993-1998.

Year	No. examined (A)	No. with adipose clips (B)	% AFC (C=B/Ax100)	Population estimate (D)	% sampled (E=A/Dx100)	Estimated adipose clips (F=B/AxD)	No. smolts [a] AFC	No. smolts [a] unclipped	No. smolts [a] % AFC	Contribution to escap. [b]	Smolt to spawner (%) [c]
1993	784	191	24.4	1,048	74.8	255	33,923	6,678	83.6	306	0.8
1994	2,416	499	20.7	2,536	95.3	524	22,986	3,348	87.3	600	2.3
1995	906	308	34.0	908	99.8	309	29,615	4,804	86.0	359	1.0
1996	1,030	218	21.2	1,039	99.1	220	10,166	2,203	82.2	268	2.2
1997	462	201	43.5	470	98.3	204	20,625	1,265	99.4	206	1.1
1998	963	212	22.0	967	99.6	213	13,566	992	93.2	228	1.6
Avg.	1,094	272	27.6	1,161	94.5	287	21,814	3,215	88.6	328	1.5

[a] smolt releases of the previous migration year; an unknown number of additional unclipped releases were likely.

[b] marked contribution to escapement = estimated adipose clips * (clipped + unclipped) / clipped.

[c] % survival = estimated AFC + AFC below the fence / AFC smolts* 100.

Table 9. Estimated Canadian and American commercial and sport harvest of Zolzap Creek CWT coho in 1998 using tag recovery data (Mark Recovery Program, Fisheries and Oceans, Canada).

Tag	Observed CWT catch [a]				Catch-sample ratio [b]			Estimated CWT catch [c]			
code	N. Troll	N. Net	Sport	Total	N. Troll	N. Net	Sport	N. Troll	N. Net	Sport	Total
Canadian[f]											
28-16-20	0	0	0	0	0.0	0.0	0.0	0	0	0	0
Total	0	0	0	0	0.0	0.0	0.0	0	0	0	0
American											
28-16-20	49	10	1	60	2.6	5.4	3.4	127	54	3	184
Total	49	10	1	60	2.6	5.4	3.4	127	54	3	184
Total	49	10	1	60	2.6	5.4	3.4	127	54	3	184

Total commercial	181
Total sport	3
Total native fishery [d]	0
Total escapement [e]	216
Total CWT	400

[a] Observed CWT = CWT's recovered from the commercial and sport catch

[b] Cumulative catch-sample ratio = total coho catch / total coho sampled

[c] Estimated CWT = observed CWT catch * catch sampling ratio

[d] observed harvest

[e] Estimated CWT's (adipose clips corrected for tag loss at return) including those below the fence, and at the fishwheels; see Table 8

[f] No coho CWT recoveries were reported in the Canadian fishery

Table 10. Expanded Canadian and American commercial and sport harvest of Zolzap Creek coho and estimated total return, 1998.

Tag code	Total release	Smolts tagged [a]	Mark rate [b]	Expanded catch [c]									Contri-bution escap.	Total return [d]
				Canadian				American				Grand Total		
				Troll	Net	Sport	Total	Troll	Net	Sport	Total			
28-16-20	14,558	13,566	1.07	0	0	0	0	136	58	4	198	198		
Total 1 [e]	14,558	13,566	1.07	0	0	0	0	136	58	4	198	198	228	426
Total 2 [f]			4.54	0	0	0	0	618	265	16	899	899	967	1,866

[a] Number smolts released with tags (corrected for tag loss), Nass and Frith (1999).

[b] Mark rate at release (= No. released / No. marked) for smolts and Total 1 (MRP method), and mark rate at return for total 2 (Escapement method).

[c] Expanded catch = EST * mark rate at release

[d] Total return = expanded catch + escapement

[e] Total 1 expanded catch is calculated using the total mark rate at release and the total estimated catch for all tag codes (Table 9).

[f] Total 2 expanded catch is calculated using the total adipose clip rate at recovery and the total estimated catch for all tag codes (Table 9).

Table 11. Estimated commercial harvest distribution of Zolzap Creek CWT coho by area and gear type, 1998. Percentage is of total commercial harvest (does not include sport recoveries).

Area [a]	Net	%	Troll	%	Total	%
Canada						
1	0	0.0	0	0.0	0	0.0
subtotal	0	0.0	0	0.0	0	0.0
U.S.A. (Alaska)						
Northern Outside	0	0.0	14	7.6	14	7.6
Central Outside	0	0.0	50	27.6	50	27.6
Southern Outside	13	7.4	19	10.5	32	17.9
Southern Inside	24	13.3	13	7.3	37	20.6
Central Inside	16	8.7	0	0.0	16	8.7
Southern Intermediate	0	0.0	32	17.6	32	17.6
Central Intermediate	0	0.0	0	0.0	0	0.0
subtotal	53	29.4	128	70.6	181	100.0
TOTAL	53	29.4	128	70.6	181	100.0

[a] includes respective sub-areas

Table 12. Adult and juvenile coho enumeration and age composition, and exploitation and survival at Zolzap Creek, 1992-1998.

Migration	Smolt Out-migration						Adult Escapement					Can		US		Total	Total
Year	Count	Estimate	CWT	% Age2	% Age3	% Age4	Count	Estimate	Return	% Age2	% Age3	%Exp.	% Cat.	%Exp.	% Cat.	%Exp.	%Surv.
1992	40,601	53,000	33,150	54.3	45.7	0.0	691	1,561	-	79.0	21.0	-	-	-	-	-	-
1993	26,334	51,000	22,649	67.9	32.1	0.0	794	1,048	2,832	58.3	41.7	15.5	24.6	47.5	75.4	63.0	2.1
1994	34,419	41,000	29,319	29.8	69.5	0.7	2,438	2,536	9,645	60.4	39.6	18.6	25.7	53.7	74.3	72.3	8.9
1995	12,369	13,000	10,156	55.1	37.9	7.0	908	908	3,057	41.3	58.7	12.9	19.0	54.8	81.0	67.7	3.6
1996	20,745	23,000	20,519	72.2	27.1	0.7	1,039	1,039	3,159	53.2	46.8	21.4	35.3	39.2	64.7	60.5	6.6
1997	15,099	18,000	13,566	65.1	34.9	0.0	470	470	1,072	70.8	29.2	8.8	16.2	45.4	83.8	54.2	2.4
1998	15,937	19,000	13,900	58.3	40.5	1.2	967	967	1,986	32.1	67.9	0.0	0.0	46.0	100.0	46.0	2.9
Average	23,643	31,143	20,466	57.5	41.1	1.4	1,044	1,218	3,625	56.4	43.6	12.9	20.1	47.8	79.9	60.6	4.4

Table 13. Adult and juvenile coho production and age composition by brood year, Zolzap Creek, 1990-1996[a].

CWTs

Brood	Smolt Production				Adult Returns			Smolts			Adults		% Total Survival			
Year	Age 2	Age 3	Age 4	Total	Age 2	Age 3	Total	% Age 2	%Age 3	%Age 4	% Age 2	%Age 3	Age 2	Age 3	Age 4	Total
1990	18,000	7,270	205	25,476	402	802	1,204	70.7	28.5	0.8	33.4	66.6	2.2	11.0	0.0	4.7
1991	15,379	20,377	711	36,466	1,223	628	1,851	42.2	55.9	1.9	66.1	33.9	8.0	3.1	0.0	5.1
1992	8,737	3,849	144	12,730	441	315	757	68.6	30.2	1.1	58.3	41.7	5.1	8.2	0.0	5.9
1993	5,596	5,561	0	11,157	359	136	495	50.2	49.8	0.0	72.5	27.5	6.4	2.4	0.0	4.4
1994	14,815	4,735	167	19,716	330	297	627	75.1	24.0	0.8	52.7	47.3	2.2	6.3	-	3.2
1995	8,831	5,630	-	14,461	140	-	140	61.1	38.9	-	-	-	1.6	-	-	1.0
1996	8,104	-	-	8,104	-	-	0	100.0	-	-	-	-	-	-	-	0.0
Avg.[b]	12,505	8,358	245	21,109	551	436	987	61.4	37.7	0.9	56.6	43.4	4.8	6.2	0.0	4.7

All fish

Brood	Smolt Production				Adult Returns			Smolts			Adults		% Total Survival			
Year	Age 2	Age 3	Age 4	Total	Age 2	Age 3	Total	% Age 2	%Age 3	%Age 4	% Age 2	%Age 3	Age 2	Age 3	Age 4	Total
1990	28,779	16,371	287	45,437	1,651	3,819	5,470	63.3	36.0	0.6	30.2	69.8	5.7	23.3	0.0	12.0
1991	34,629	28,495	910	64,034	5,826	1,794	7,620	54.1	44.5	1.4	76.5	23.5	16.8	6.3	0.0	11.9
1992	12,218	4,927	161	17,306	1,263	1,478	2,741	70.6	28.5	0.9	46.1	53.9	10.3	30.0	0.0	15.8
1993	7,163	6,233	0	13,396	1,681	313	1,994	53.5	46.5	0.0	84.3	15.7	23.5	5.0		14.9
1994	16,606	6,282	228	23,116	759	1,348	2,107	71.8	27.2	1.0	36.0	64.0	4.6	21.5	-	9.1
1995	11,718	7,695	-	19,413	638	-	638	60.4	39.6	-	-	-	5.4	-	-	3.3
1996	11,077	-	-	11,077	-	-	0	100.0	-	-	-	-	-	-	-	0.0
Avg.[b]	19,879	12,462	317	32,658	2,236	1,751	3,987	62.7	36.5	0.8	54.6	45.4	12.2	17.2	0.0	12.8

[a] (-) Incomplete data for 1995 and 1996, to be completed with data from subsequent returns.

[b] average for "Total" includes years for which complete production data is available.

FIGURES

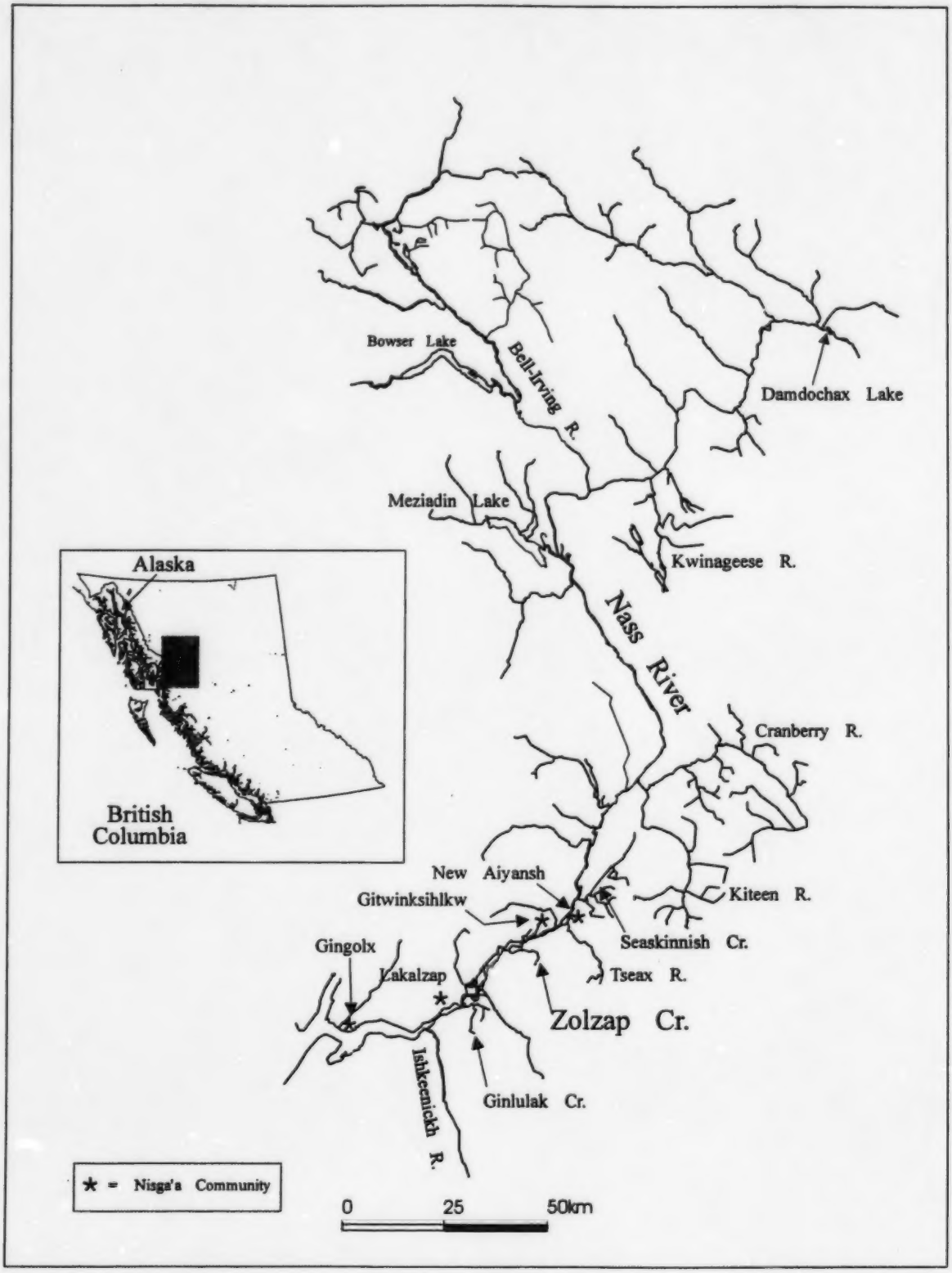

Figure 1. The Nass River watershed, British Columbia.

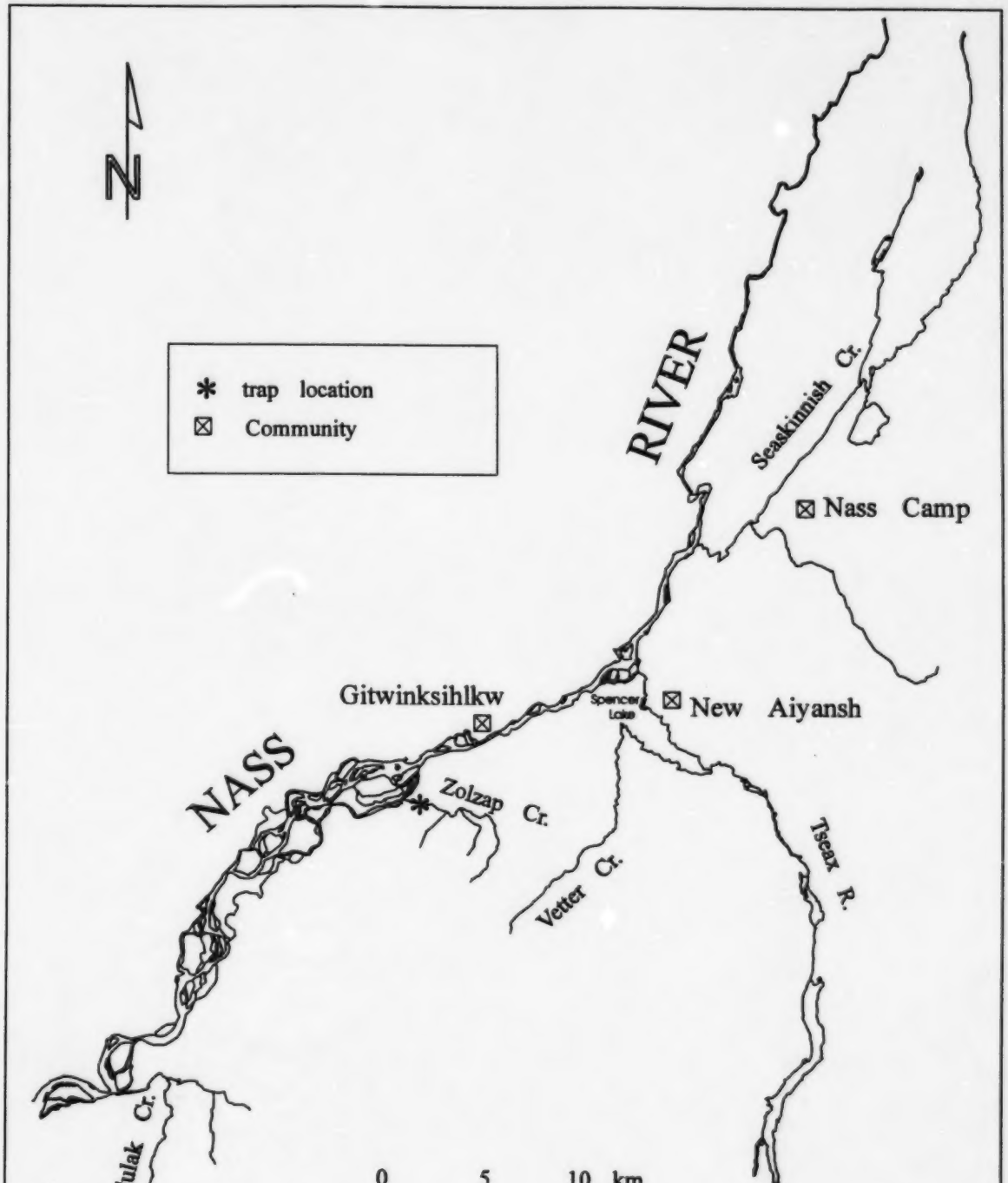

Figure 2. Zolzap Creek and location of enumeration fence.

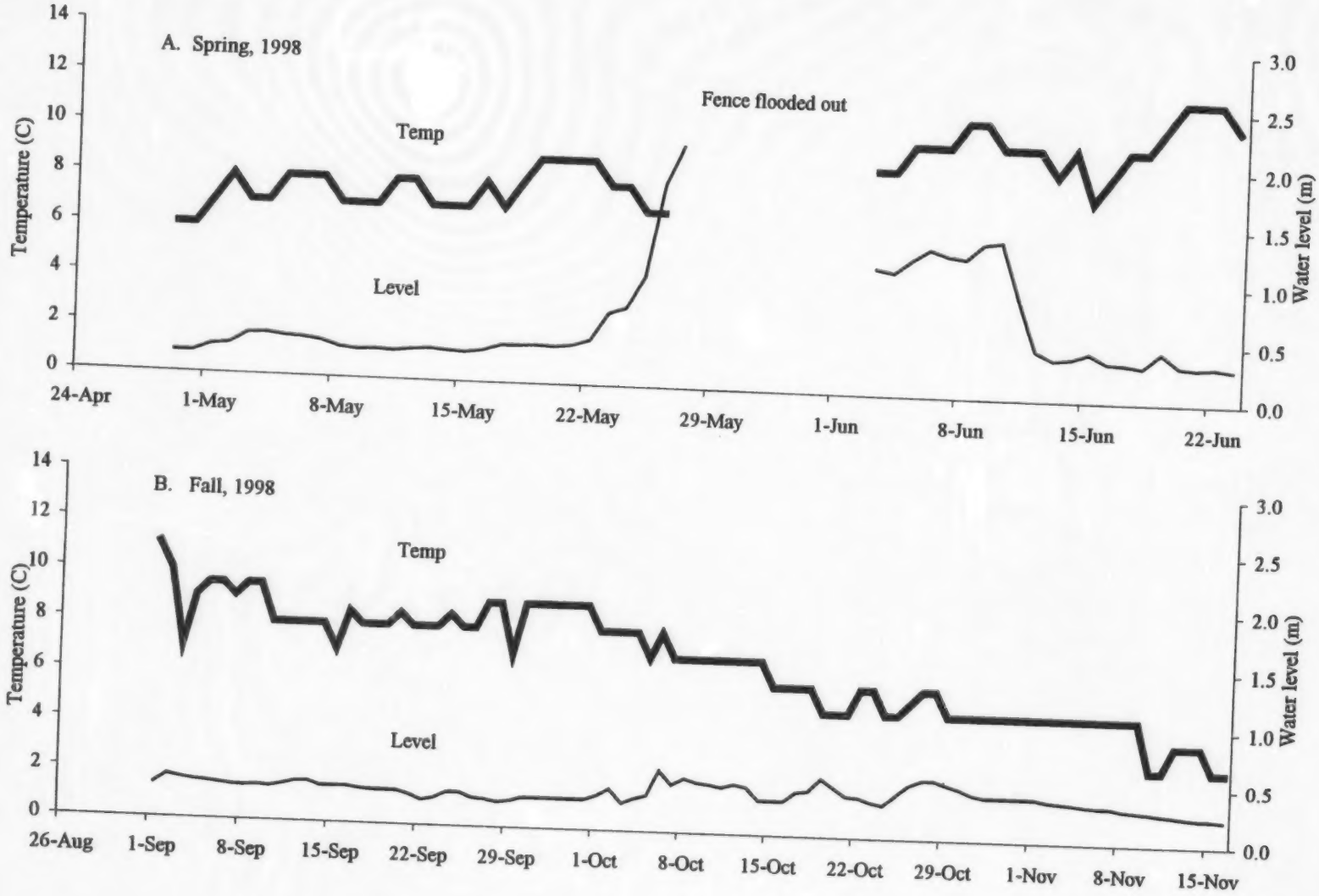

Figure 3. Water level and temperature at Zolzap Creek, 1998.

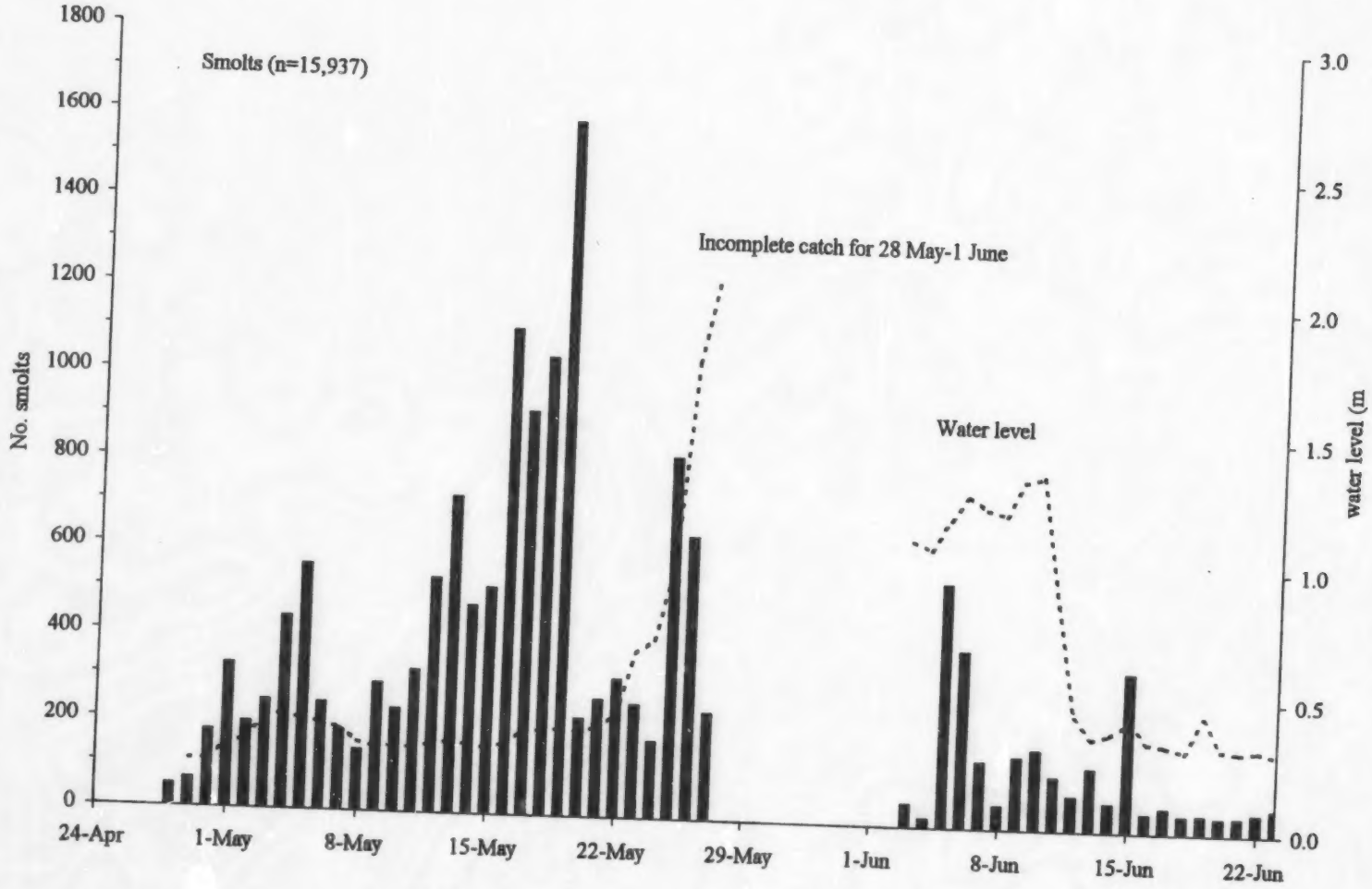

Figure 4. Daily migration of coho smolts at Zolzap Creek, 29 April - 23 June, 1998.

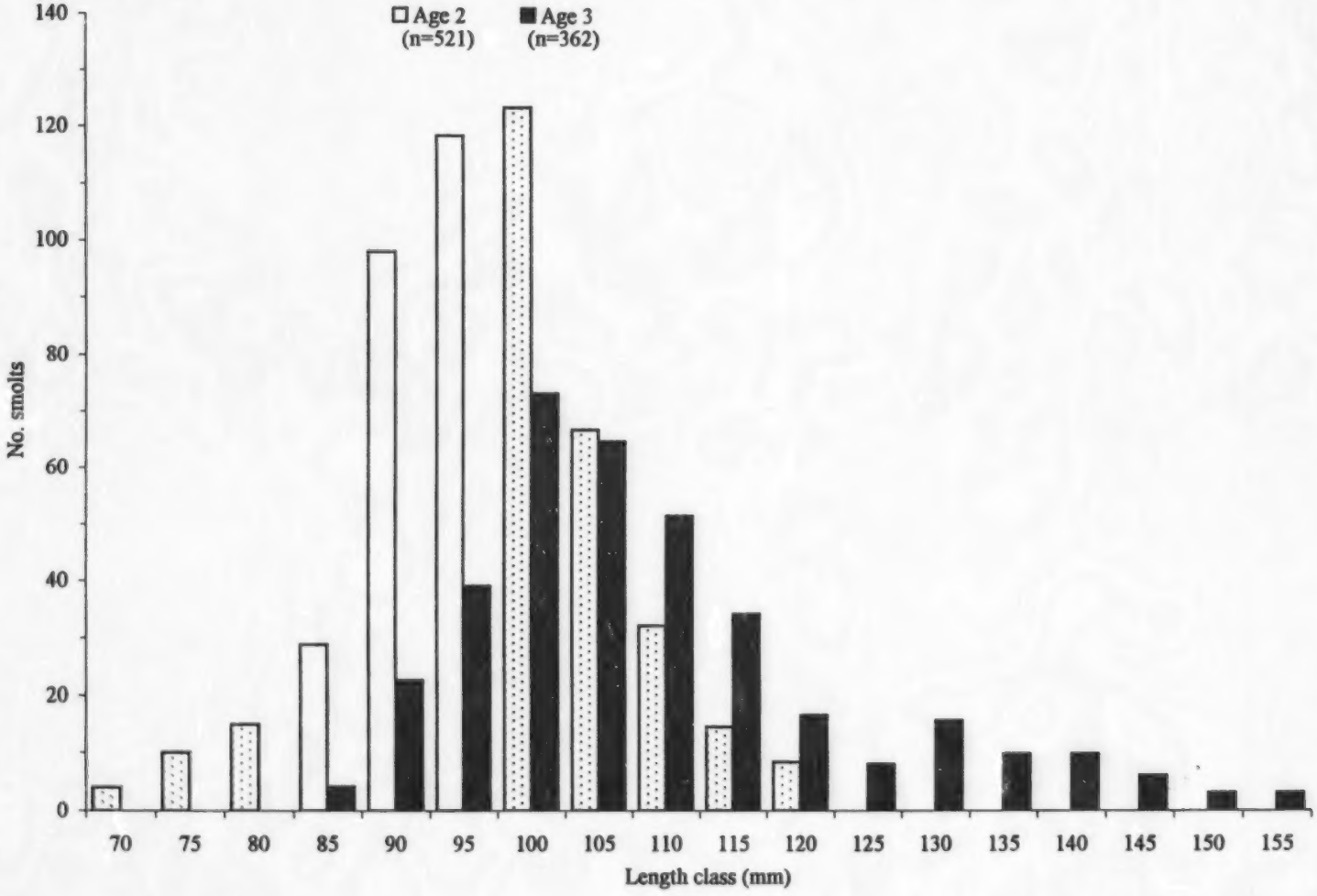

Figure 5. Length-frequency and calculated age distribution of Zolzap Creek coho smolts, 1998. Age 4 samples are excluded due to low sample sizes.

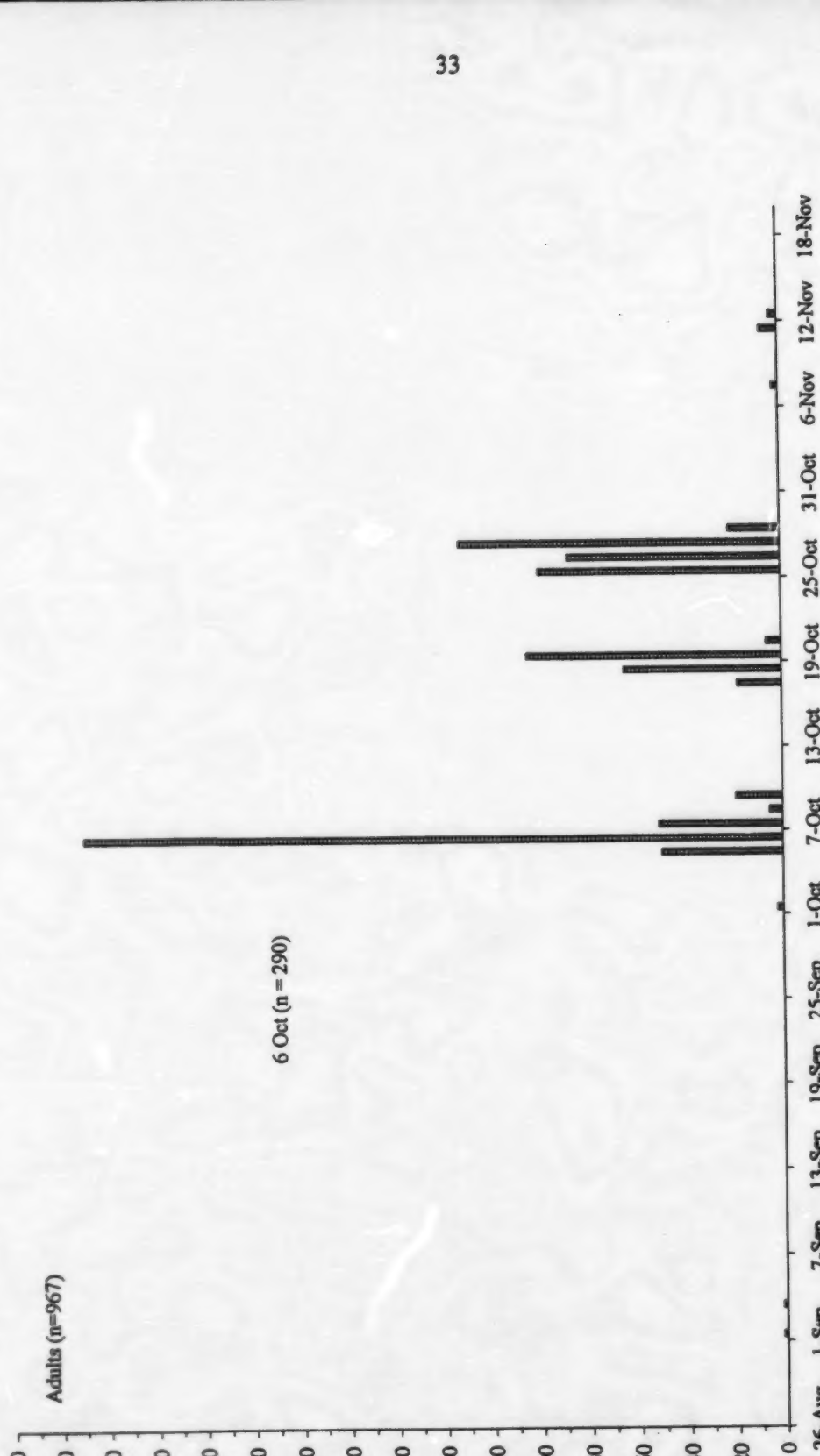

Figure 6. Daily counts of adult coho at the Zolzap Creek enumeration fence, 31 Aug - 19 Nov, 1998.

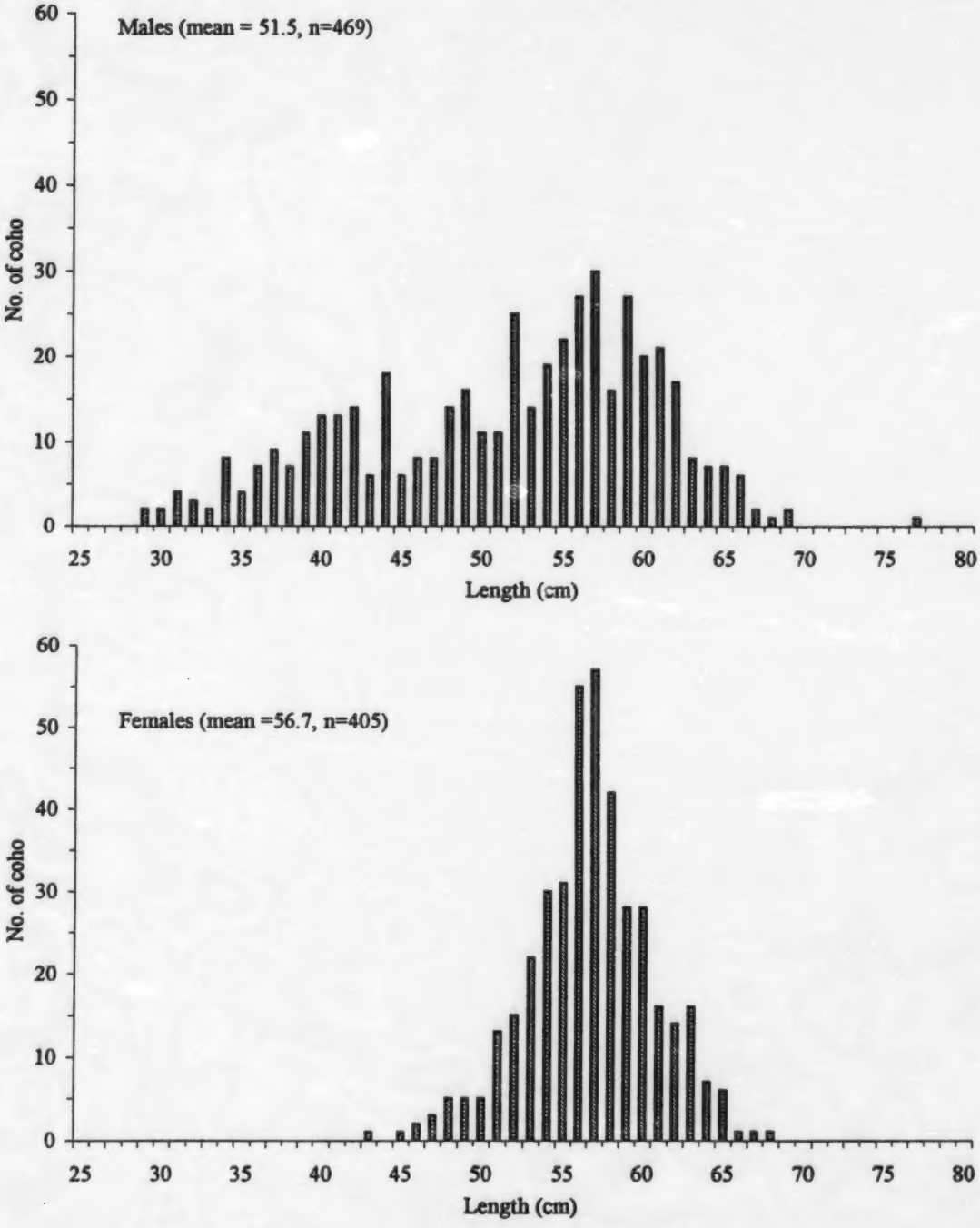

Figure 7. Length-frequency distribution of adult coho, by sex, Zolzap Creek, 1998.

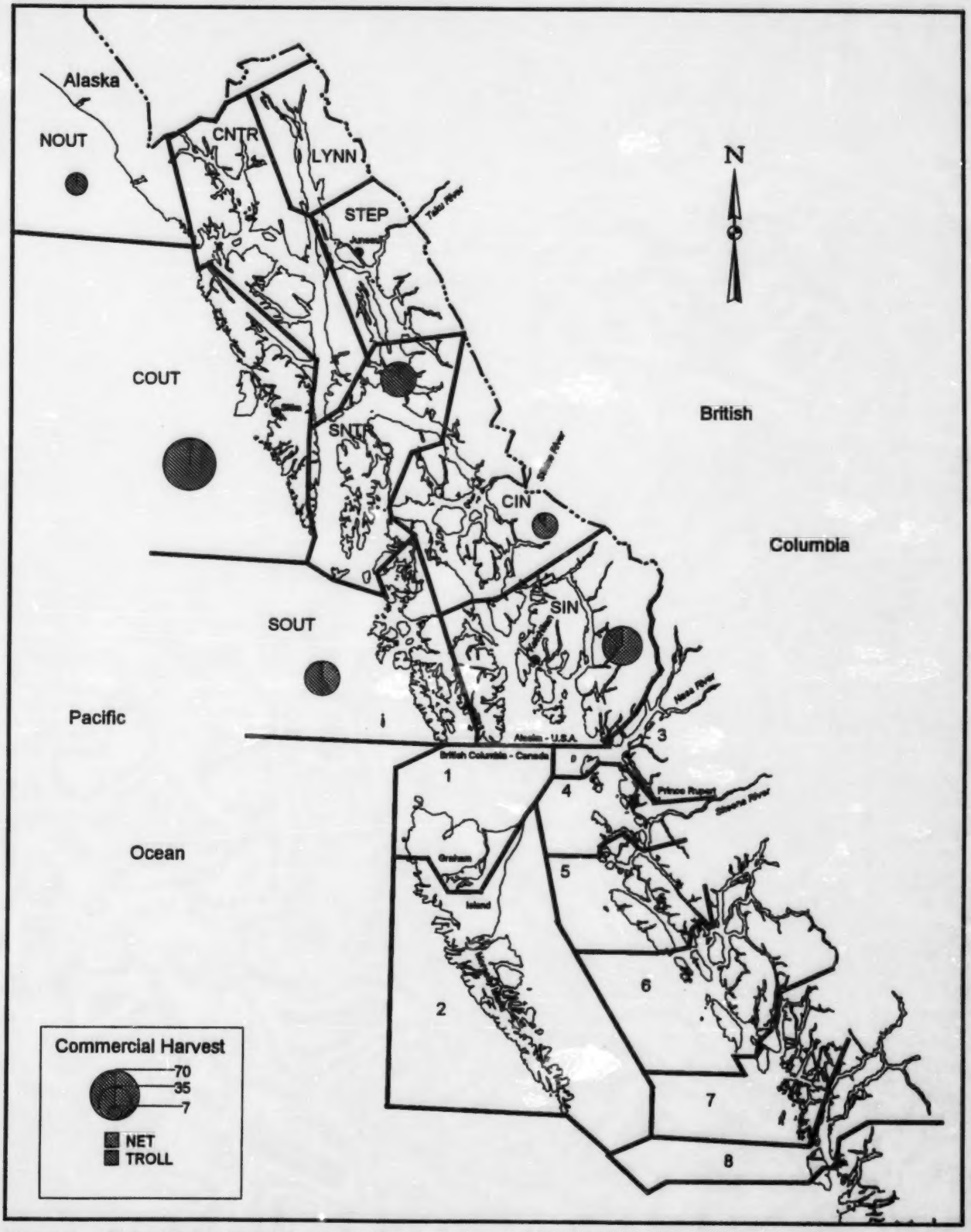

Figure 8. Fisheries Statistical Areas for the north coast of British Columbia and southeast Alaska, and commerical harvest distribution of Zolzap Creek CWT coho, 1998.

APPENDICES

Table A-1. Juvenile coho catch at Zolzap Creek enumeration fence, 1998.

Date	fry/presmolts	smolts	morts
28-Apr	16	46	6
29-Apr	6	62	2
30-Apr	13	172	0
1-May	2	326	1
2-May	2	192	0
3-May	0	243	2
4-May	0	436	0
5-May	3	557	0
6-May	3	241	0
7-May	0	179	0
8-May	2	134	0
9-May	1	288	0
10-May	3	231	1
11-May	1	321	0
12-May	5	533	2
13-May	0	722	0
14-May	2	472	0
15-May	0	514	0
16-May	2	1,110	0
17-May	0	922	0
18-May	2	1,047	0
19-May	0	1,593	0
20-May	0	220	0
21-May	2	264	0
22-May	0	312	0
23-May	0	254	0
24-May	3	171	0
25-May	3	827	0
26-May	28	645	0
27-May	253	241	0
28-May	0	0	0
29-May	0	0	0
30-May	0	0	0
31-May	70	0	0
1-Jun	0	0	0
2-Jun	0	0	0
3-Jun	7	49	0
4-Jun	5	19	0
5-Jun	5	554	0
6-Jun	12	401	0
7-Jun	3	149	0
8-Jun	8	51	0
9-Jun	2	162	0
10-Jun	0	179	0
11-Jun	2	119	0
12-Jun	9	76	0
13-Jun	38	141	0

Table A-1. Juvenile coho catch at Zolzap Creek enumeration fence, 1998.

Date	fry/presmolts	smolts	morts
14-Jun	11	63	0
15-Jun	54	360	0
16-Jun	25	39	0
17-Jun	74	54	0
18-Jun	56	37	0
19-Jun	210	39	0
20-Jun	158	35	0
21-Jun	148	36	0
22-Jun	130	44	0
23-Jun	149	55	0
Total	1,528	15,937	14

Table B-1. Non-coho catch at Zolzap Creek enumeration fence, 1998.

Date	Steelhead		Cutthroat		D. Varden		Sockeye	Chum			
	Juvenile	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile	Juvenile	Cottid	Lamprey	Stickleback
28-Apr	3	0	4	6	31	3	6	15	7	10	7
29-Apr	4	0	16	4	29	0	0	26	11	118	6
30-Apr	4	0	11	12	24	0	0	32	3	199	12
01-May	13	0	26	15	41	4	0	28	9	73	18
02-May	4	0	20	3	22	0	0	46	12	55	19
03-May	2	0	9	0	25	0	0	87	11	553	17
04-May	2	0	13	0	20	1	0	50	1	519	4
05-May	0	0	3	4	24	0	0	28	4	162	18
06-May	5	0	11	4	27	0	2	10	1	33	2
07-May	0	0	1	0	20	0	0	10	4	55	10
08-May	2	0	8	2	10	1	0	8	4	30	11
09-May	1	0	11	5	27	2	6	17	6	26	9
10-May	1	0	27	1	15	0	0	16	4	26	3
11-May	4	0	21	9	25	3	1	1	8	10	6
12-May	4	0	13	14	45	3	2	15	2	24	4
13-May	5	0	11	4	16	2	0	13	1	18	6
14-May	2	0	3	0	19	0	0	16	4	28	7
15-May	0	0	0	0	21	1	1	19	2	49	1
16-May	7	0	13	15	31	1	6	14	5	9	4
17-May	6	0	21	16	15	4	1	30	10	19	11
18-May	2	0	2	0	24	0	2	12	0	8	5
19-May	2	0	3	0	13	0	3	8	1	19	5
20-May	0	0	1	0	3	0	1	7	1	51	7
21-May	0	0	1	1	11	0	0	1	0	3	2
22-May	6	0	3	0	4	0	0	8	0	2	3
23-May	0	0	1	0	0	0	0	4	1	3	1
24-May	0	0	0	0	1	0	0	4	1	5	0
25-May	1	0	3	1	8	0	2	6	0	2	1
26-May	0	0	0	0	6	0	0	1	8	0	1
27-May	0	0	1	0	23	0	0	6	27	0	8

Table B-1. Non-coho catch at Zolzap Creek enumeration fence, 1998.

Date	Steelhead		Cutthroat		D. Varden		Sockeye	Chum			
	Juvenile	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile	Juvenile	Cottid	Lamprey	Stickleback
28-May	0	0	0	0	0	0	0	0	0	0	0
29-May	0	0	0	0	0	0	0	0	0	0	0
30-May	0	0	0	0	0	0	0	0	0	0	0
31-May	0	0	2	0	61	0	0	6	77	4	7
01-Jun	0	0	0	0	0	0	0	0	0	0	0
02-Jun	0	0	0	0	0	0	0	0	0	0	0
03-Jun	1	0	0	0	0	0	2	0	0	3	2
04-Jun	0	0	0	0	0	0	1	0	0	3	0
05-Jun	0	0	0	0	8	0	0	0	5	2	2
06-Jun	0	0	2	0	4	0	1	0	28	3	0
07-Jun	0	0	0	0	2	0	1	0	2	1	1
08-Jun	0	0	0	0	2	0	0	0	3	4	2
09-Jun	0	0	0	0	0	0	8	0	0	2	1
10-Jun	0	0	0	0	1	0	36	0	0	1	2
11-Jun	0	0	1	0	0	0	4	3	0	2	1
12-Jun	0	0	1	0	1	0	9	0	0	17	2
13-Jun	0	0	0	0	0	0	114	0	17	144	11
14-Jun	1	0	0	0	4	0	46	0	11	9	2
15-Jun	0	0	1	0	9	0	180	0	3	12	9
16-Jun	0	0	0	0	3	0	82	0	5	32	3
17-Jun	0	0	2	0	5	0	26	1	3	7	5
18-Jun	0	0	0	1	8	0	57	1	2	21	5
19-Jun	0	0	1	0	11	0	36	0	4	8	1
20-Jun	0	0	1	0	9	0	60	0	4	7	6
21-Jun	0	0	0	0	3	0	33	0	1	8	6
22-Jun	0	0	0	0	14	0	47	0	3	2	1
23-Jun	0	0	0	0	7	0	22	0	1	7	4
Total	82	0	268	117	732	25	798	549	317	2408	281

Table C-1. Coded-wire tagging data for coho smolts at Zolzap Creek, 1998.

Date	Total smolts	Fence morts	Tag code	No. AFC	Tag morts	No. rlsd. untagged	No. rlsd. AFC
28-Apr	46	0	0	0	0	46	0
29-Apr	62	0	0	0	0	62	0
30-Apr	172	0	0	0	0	172	0
01-May	326	5	0	0	0	321	0
02-May	192	0	0	0	0	192	0
03-May	243	0	0	0	0	243	0
04-May	436	0	0	0	0	436	0
05-May	557	1	0	0	0	0	0
06-May	241	0	28-16-21	788	10	5	778
07-May	179	0	28-16-21	179	8	0	171
08-May	134	0	0	0	0	0	0
09-May	288	0	0	0	0	0	0
10-May	231	1	0	0	0	0	0
11-May	321	1	28-16-21	963	15	8	948
12-May	533	2	28-16-21	529	7	1	522
13-May	722	0	0	0	0	0	0
14-May	472	0	28-16-21	1,175	6	14	1,169
15-May	514	0	0	0	0	0	0
16-May	1,110	0	28-16-21	1,603	12	14	1,591
17-May	922	2	28-16-21	914	6	6	908
18-May	1,047	0	28-16-21	1,025	4	22	1,021
19-May	1,593	0	28-16-21	1,586	6	6	1,580
20-May	220	0	0	0	0	0	0
21-May	264	0	28-16-21	471	3	13	468
22-May	312	0	0	0	0	0	0
23-May	254	0	28-16-21	554	3	8	551
24-May	171	0	0	0	0	0	0
25-May	827	0	28-16-21	986	7	10	979
26-May	645	0	28-16-21	643	2	2	641
27-May	241	0	28-16-21	238	4	2	234
28-May	0	0	0	0	0	0	0
29-May	0	0	0	0	0	0	0
30-May	0	0	0	0	0	0	0
31-May	0	0	0	0	0	0	0
01-Jun	0	0	0	0	0	0	0
02-Jun	0	0	0	0	0	0	0
03-Jun	49	0	0	0	0	3	0
04-Jun	19	0	0	0	0	0	0
05-Jun	554	0	28-16-21	552	3	1	549
06-Jun	401	0	0	0	0	1	0
07-Jun	149	0	28-16-21	549	4	1	545
08-Jun	51	0	0	0	0	1	0
09-Jun	162	0	0	0	0	2	0
10-Jun	179	0	0	0	0	1	0

Table C-1. Coded-wire tagging data for coho smolts at Zolzap Creek, 1998.

Date	Total smolts	Fence morts	Tag code	No. AFC	Tag morts	No. rlsd. untagged	No. rlsd. AFC
11-Jun	119	0	28-16-21	505	5	1	500
12-Jun	76	4	0	0	0	1	0
13-Jun	141	0	0	0	0	2	0
14-Jun	63	0	0	0	0	1	0
15-Jun	360	0	28-16-21	630	3	2	627
16-Jun	39	0	0	0	0	0	0
17-Jun	54	0	0	0	0	0	0
18-Jun	37	0	0	0	0	0	0
19-Jun	39	0	28-16-21	168	0	1	168
20-Jun	35	0	0	0	0	35	0
21-Jun	36	0	0	0	0	36	0
22-Jun	44	0	0	0	0	44	0
23-Jun	55	0	0	0	0	55	0
Total	15,937	16	-	14,058	108	1,771	13,950

Table D-1. Daily counts of adult coho at Zolzap Creek enumeration fence, 1998.

Date	No. examined	No. operculum tagged
01-Sep	1	0
02-Sep	0	0
03-Sep	1	1
04-Sep	0	0
05-Sep	0	0
06-Sep	0	0
07-Sep	0	0
08-Sep	0	0
09-Sep	0	0
10-Sep	0	0
11-Sep	0	0
12-Sep	0	0
13-Sep	0	0
14-Sep	0	0
15-Sep	0	0
16-Sep	0	0
17-Sep	0	0
18-Sep	0	0
19-Sep	0	0
20-Sep	0	0
21-Sep	0	0
22-Sep	0	0
23-Sep	0	0
24-Sep	0	0
25-Sep	0	0
26-Sep	0	0
27-Sep	0	0
28-Sep	0	0
29-Sep	0	0
30-Sep	0	0
01-Oct	2	2
02-Oct	0	0
03-Oct	0	0
04-Oct	0	0
05-Oct	50	47
06-Oct	290	278
07-Oct	51	50
08-Oct	5	5
09-Oct	19	19
10-Oct	0	0
11-Oct	0	0
12-Oct	0	0
13-Oct	0	0
14-Oct	0	0
15-Oct	0	0

Table D-1. Daily counts of adult coho at Zolzap Creek enumeration fence, 1998.

Date	No. examined	No. operculum tagged
16-Oct	0	0
17-Oct	18	18
18-Oct	65	65
19-Oct	105	104
20-Oct	6	6
21-Oct	0	0
22-Oct	0	0
23-Oct	0	0
24-Oct	0	0
25-Oct	100	99
26-Oct	88	87
27-Oct	133	133
28-Oct	21	21
29-Oct	0	0
30-Oct	0	0
31-Oct	0	0
01-Nov	0	0
02-Nov	0	0
03-Nov	0	0
04-Nov	0	0
05-Nov	0	0
06-Nov	0	0
07-Nov	2	2
08-Nov	0	0
09-Nov	0	0
10-Nov	0	0
11-Nov	7	7
12-Nov	3	3
Totals	967	947